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PIERCING THE FOG OF WAR SURROUNDING FRATRICIDE: THE SYNERGY OF HISTORY, TECHNOLOGY, AND BEHAVIORAL RESEARCH

by

Colonel Kenneth K. Steinweg
United States Army

Colonel Stephen Bowman
Project Advisor

U.S. Army War College
Carlisle Barracks, Pennsylvania 17013

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ABSTRACT

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Author: COL Kenneth K. Steinweg, USA

Fratricide rates have generally been acknowledged to be less than two percent of all friendly casualties. Review of the historical evidence from small individual medical studies on casualties and official medical reports from most of the 20th century conflicts demonstrate a consistent fratricide rate of 10-15 percent.

Analysis of fratricide data collected from the three combat training centers (National Training Center, Joint Readiness Training Center, Combat Maneuver Training Center) confirm a much higher rate and reveal three separate methods of fratricide computation and presentation. These three methods reflect markedly different methodology and interpretation. They are not interchangeable methods nor are they comparable. However, fratricide data using different methods of computation are often presented side-by-side.

These fratricide rates five to eight times the previously acknowledged rate can be explained by (1) the baseline human skill and abilities with the weapon systems on hand and (2) the severe effects of combat stressors, such as sleep deprivation, in degrading abilities and judgment.

Many factors are pushing us inexorably toward a technology-based ground fratricide prevention system: (1) Our much higher fratricide rate is politically unacceptable. (2) It is an unacceptable detractor of combat power, and its solution can provide an advantage over our foes on the battlefield. (3) Our present preventative measures are not effective enough. Our training centers and combat experience demonstrate this point. (4) The characteristic continuous nature and fluid lines of the modern battlefield increase the opportunity for fratricide because of their degradation of combat skills. (5) Technology will force us to address the issue. Weapon systems have increased in sophistication and range, and have outpaced the operator's ability to determine the friend or foe nature of the target. (6) Similar weapon systems shared by friend and foe will require us to move toward a ground identification system. (7) Joint doctrine influence will require mixing of armed forces to an extent not yet attempted. (8) The Force Projection strategy of the National Military Strategy will increase the factors favorable to fratricide. Increased travel time before combat and time zone adjustment will all degrade combat ability shortly after arrival in theater. (9) Battlefields of the future with nuclear, biologic, or chemical agents will increase fratricide rates.

All these factors lead to the conclusion that a technology-based anti-fratricide system is now needed as an additional preventative measure. This is required because there will be future battlefields that all services will share. There are several promising technology-based fratricide prevention equipment items in development. This technology will be expensive but will significantly decrease losses of equipment and soldiers.

The armed forces must acknowledge the magnitude of the fratricide rates and be willing to pay for a solution. The American people expect nothing less.

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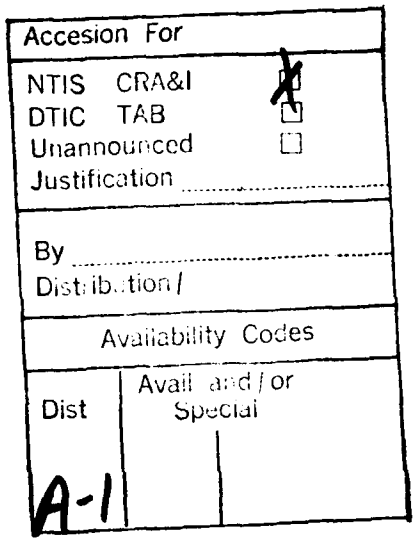

INTRODUCTION

The recent tragic downing of two U.S. Army helicopters over Iraq by two U.S. Air Force jets has once again pushed fratricide into the national spotlight. The intense public scrutiny over the17 percent fratricide rate in the Persian Gulf War was just subsiding when this new reminder of fratricide appeared. As demonstrated by this most recent incident, it is a multi-service, joint problem. The consciousness, indeed the very soul of the armed forces, has been stirred by this issue. For those hoping the problem will go away, it will not.

Some sources imply that the high fratricide rate of the Persian Gulf War is a new phenomenon, a direct result of the lethality and technology of the weapons of modern war.[1] Others state that the Persian Gulf War rates are due to the little time for combat seasoning, "which invariably reduces the frequency of friendly fire."[2] These arguments overstate the cause and understate the issue. Fratricide is such a sensitive topic that few people have attempted to study it, and only recently is it being acknowledged as an issue on the battlefield to be confronted and a solution developed to reduce its awful cost. The deep psychological and cultural factors and the fog of war associated with fratricide have made it a pariah until recent times.

This paper will examine the historical evidence of Army-incurred fratricide rates during the conflicts of the twentieth century to build a case for rates at least five times what was considered the generally accepted rate of two percent.[3] The experiences at our national training centers and the technologies put to use there will confirm this possibility. Finally, four decades of behavioral research will help explain the reasons why our fratricide rates have always been so high and why these rates will be resistant to further decreases. There are serious implications for doctrine and fratricide prevention techniques and technologies. These implications impact on all of the nation's armed services.

FRATRICIDE: DEFINITION AND CALCULATION CONTROVERSIES

Any discussion of fratricide must first settle the issue of its definition. At first glance, it would seem simple: The wounding of a soldier by his own troops. However, specific examples illustrate the difficulty and demonstrate the need for a rigorous definition. Weapon malfunctions, weapon cleaning accidents, and deliberate self and friendly wounding have been included in the combat casualty data in the past. The recently adopted U.S. Training and Doctrine Command (TRADOC) definition narrows the conditions for inclusion under the heading of fratricide.

> Fratricide is the employment of friendly weapons and munitions with the intent to kill the enemy or destroy his equipment or facilities, which results in unforeseen and unintentional death or injury to friendly personnel.[4]

The qualification in this definition that makes it so restrictive is the portion "with the intent to kill the enemy or destroy his equipment or facilities." This eliminates accidental weapon explosions and misfires, training accidents, or unintentional self wounding of any kind.

An unexpected controversy, little appreciated by the lay public and difficult for all to understand, is the method of presenting fratricide information. What follows is a complex but necessary discussion of the three ways fratricide computations are presented. They are not directly comparable methods. Often the methods are intermixed or used interchangeably with no clear notation of method. This further muddies a problem area that is already difficult to understand.

The first method is the historical and traditional formula for fratricide calculation:

$$\frac{\text{number of friendly troops a casualty by friendly fire}}{\text{total number of friendly casualties}}$$

This is simply a ratio between two groups of friendly casualties. It is the conventional method and is used in all historical examples to be presented here. It can be misleading. If friendly soldiers are efficient at dispatching the enemy with few casualties from the enemy, fratricide as a percentage of total friendly casualties would be high. This reason is given as

one explanation for the Persian Gulf War rate. This method of fratricide calculation is used at the Joint Readiness Training Center (JRTC) at Fort Polk, LA.

The definition of fratricide states that the friendly troops must be injured while trying to inflict injury on the enemy. Therefore, some sources argue that a more accurate and fair way of depicting fratricide is to change the denominator of the first equation to reflect enemy casualties.[5] This results in the following formula:

$$\frac{\text{number of friendly troops a casualty by friendly fire}}{\textbf{total number of enemy casualties inflicted}}$$

The advantage of using this second method is that it relates the effectiveness of inflicting enemy casualties to the mistakes of wounding a friendly soldier. Well trained soldiers and brilliant strategy may inflict huge losses on the enemy resulting in very low percentages of fratricide. A slightly modified version of this method is used at the National Training Center (NTC) at Fort Irwin, CA.

There are major difficulties with this method of calculation in combat operations. Obtaining enemy casualty data for the same time period as friendly fire data was collected is extremely difficult given the nature of some of our previous enemies (Chinese, North Koreans, North Vietnamese, Viet Cong, Iraqis) and war itself. Several attempts were made to compile enemy and friendly casualties for the same battle or time period during the Korean War. One study over a sixty day period is full of ambiguity, missing data, and assumptions with resultant wildly fluctuating estimates of casualty ratios between enemy and friendly forces from 3:1 to 1:1.[6] A second detailed Korean War study (370 pages and covering a single battle over a period of one month of combat) gathered all available information on opposing sides. Called a "limited vertical slice of combat" and with many adjustments for missing and contradictory data, this study derived enemy to friendly casualty ratios of 2:1 to 2.5:1.[7] There is no mention in this reference of fratricide in spite of extensive information on casualty data. Any conclusion is suspect.

Just as importantly, if using this second method of calculation, not every enemy casualty should be counted. In an example related to the Persian Gulf War, if 100,000 Iraqis were casualties, American fratricide rates would be a fraction of a percent. But is it fair to count all enemy casualties in the denominator or only those that are at risk from the soldiers they face? An Iraqi soldier 200 miles to the rear of his lines getting bombed by the Air Force is not a target engaged by American ground soldiers. This enemy should not be part of the denominator in the new equation either. Deciding which enemy casualty is at risk and should be included in the denominator makes this second method of calculation very difficult. In examining the historical record, it appears that we will be forced to use the first method of calculation.

Finally, there is a third method of presenting fratricide data: raw total numbers with no denominator. Whereas the first method discussed relates fratricide to total friendly killed and wounded, and the second to enemy killed and wounded, this third method relates to nothing. This third method uses raw total numbers of U.S. soldier casualties. The number stands out starkly in a one to one ratio with human life. Air Force related fratricide cases are often presented this way. The Combat Maneuver Training Center (CMTC) in Hohenfels, Germany, uses this method of fratricide data presentation.

In summary, careful attention must be paid to the method used to present fratricide information. Mixing methods in fratricide discussions compares facts based on entirely different logic and emphasis.

LIMITATIONS IN EXAMINING HISTORICAL EVIDENCE OF FRATRICIDE

In rooting out fratricide data, there are a number of issues that make analysis very difficult. First, estimates of fratricide rates from official records are difficult to find. Although its presence on the battlefield has been known for centuries, there was no clear reporting requirement in use before the 1985 edition of AR 600-10, The Army Casualty System.[8] The TRADOC definition discussed above was not published until 1991. The

edition of AR 600-10 in use during the Vietnam War resulted in friendly casualties being classified as "Killed in Action" or "Result of Hostile Fire."[9]

Second, there is tremendous bias against officially reporting fratricide in war. It is such a sensitive topic that few people have attempted to study it. Until very recently, no one has systematically looked at the issue. The assumption that fratricide is a rare event reinforced these biases. The Persian Gulf War exposed the issue for all to see.

Third, the confusion of battle and the difficulty of actually knowing what happened in combat means that what little data is available probably understates the case. This is particularly the case in close man-to-man fighting and close artillery support. In most official records, all wounds are attributed to the enemy.

Fourth, collection and recording of casualty data initially takes place at medical facilities, usually far from the place of injury, and without benefit of questions regarding source of injury. But in reality, casualty data collection and reporting are Adjutant General (AG) functions and so are usually reported as gross numbers and totals devoid of much clinical or causative data except such categories as "bullet wounds," "shrapnel," "mines," or in the case of World War I, "gas." In addition, these AG reports are essentially roll-ups of other reports, never derived from actual patient contact. Facts and issues not originally sought will not be found, recorded, and forwarded. Only in smaller unit reports or unofficial individual records will such evidence be available.

Fifth, the myriad of sources where fratricide might be discovered results in comparisons of different types of data. Personal memoirs on one hand may be the best source available in one battle, while occasionally battle reports or special studies may allude to the issue and allow conclusions to be drawn. By necessity, a variety of types of data have to be used when studying fratricide. All combat examples will involve a very small percentage of all casualties incurred in any given war, but by themselves they tell a compelling story, and some can be generalized on a much larger scale.

Lastly, representative battles and campaigns need to be used to reflect the consistency of fratricide, rather than well-known worst case examples. Such worst case examples are plentiful enough. Only one such worst case will be mentioned below to demonstrate a point. The circumstances used in each analysis will be explained so that the veracity of the information presented can be judged. There is nothing about the examples discussed, with the aforementioned exception, to think they are outside the realm of ordinary occurrences.

HISTORICAL SEARCH

The most comprehensive compilation of fratricide examples and cases was published in a landmark study by LTC Charles R. Shrader in 1982. In his examination of 269 different incidents he acknowledges the extreme difficulty in developing accurate rates but provides his best assessment. "It appears that amicicide [fratricide] incidents account for something less that 2 percent of all casualties in battle."[10] He repeats this assessment of the rate in a publication a decade later. "There are sound reasons to consider two percent of total casualties as a good working order of magnitude for amicicidal casualties, but as many critics have pointed out, the true number may be much higher."[11] Trevor Dupuy in his 1990 book on attrition and battle casualties states, "There are no accurate statistics for fratricide...The average proportions more likely no more than 2 percent of casualties incurred."[12] He cites no references for his figure. Against this background the Persian Gulf War fratricide data look terrible. Is this fratricide rate really inconsistent with what can be made of historical precedence? Such a controversy requires a search of relevant casualty data and medical reports.

This search will commence with one of the first conflicts of the twentieth century. On the eve of World War I, the Army was involved in the Mexican Punitive Expedition in 1916-1917 to track down Pancho Villa. This conflict was small, involving on average approximately 8,300 troops, and lacked any large scale clashes. The Army Medical

Department did classify injuries by disease and method of injury.[13] Of the published data on casualties by the Surgeon General's Office, " number [of friendly troops] shot by guard" is recorded as "4/1000." The casualty rate is recorded as 41/1000. This results in a ten percent fratricide rate (4/41) using method one (friendly troops wounded by friendly fire/ total friendly casualties). This small action only incurred 40 deaths and several hundred wounded in 1916. This rate of fratricide does not include artillery fire, perhaps the most frequent cause of friendly fire. This conflict was characterized by small skirmishes and artillery was rarely employed. The fratricide associated with this expedition begins to lay the ground on which to challenge old assumptions.

World War I presents a tremendous problem in trying to dig out facts. Early casualty rates by American forces were so high, so quickly, that it overwhelmed the casualty collecting system in place.[14] The meticulous categories used in the Mexican Punitive Expedition were thrown out with the thousands of gas, machine gun, and artillery casualties mixed in with the rampant disease rates. Over ten thousand medical records were lost. Only the grossest of casualty types are reported. It is in this kind of chaotic environment that personally-kept records may give the best insight.

The personal records of a Regimental Aid Station physician, attributed to Dr. L. D. Besecker, from the 23d Infantry Regiment, 2nd Infantry Division, during March-June 1918 is very instructive. Each patient treated is meticulously logged in by name, identification number, description of wounds, status, evacuation data, and agent of wounding. It is here that he carefully documents wounds by friendly fire. Of the eighty-two combat casualties identified during this period, at least eight (10 percent) were caused by friendly fire. The 2nd Division arrived in France in late 1917 and trained extensively before entering the lines in March 1918. The abrupt ending of the log in June 1918 coincides in time with a large German offensive against the 2nd Division and probably reflects the fact that the author was overwhelmed by sheer volume of patients.[15]

Following World War I, French General Alexandre Percin alleged in his book Le Massacre de notre Infanterie that 75,000 of France's 3.3 million artillery casualties were due to artillery fratricide.[16] He derived a 2.2 percent fratricide rate from a medical study at the beginning of the war, which he quickly indicated was obviously too low.

> I am certainly far below the reality [artillery fratricide rate], for the statistic from which General Poline relates to the start of the war, while the incidents involving heavy artillery--Verdun, clearly showed this,-- were far more numerous once trench warfare was established.[17]

General Percin cites numerous examples with higher rates in the appendix of his book, including one study revealing that 2 out of every 10 shells that fell on the trenches were from friendly artillery. General Percin appears to endorse the estimate of 20 percent proposed by a French general he considered "sympathetic" to the artillery. Many have used General Percin's 2.2 percent figure of artillery fratricide as a properly calculated number and one that he supported. This is not the case.

The British had similar problems with artillery fratricide that were also related to tactics.

> "The 'creeper' [rolling barrage] covered the ground progressively in front of and behind the objectives. All the infantry had to do was to stay close to it [the artillery barrage] even if the occasional short round sprayed them with shrapnel."[18]

Dr. Besecker, in his earlier account, did not attempt to sort out friendly versus enemy artillery injuries, the common problem alluded to by General Percin. Given the fact that American troops trained extensively with the French prior to commitment to the front and initially were piecemealed among French units, there is good reason to believe that American units also suffered from artillery fratricide. This undoubtedly makes Dr. Besecker's data on fratricide also a low total estimate.

World War II, with its size and the duration of American involvement, provided several possible ways of obtaining representative data. It is in medical reports from this war that we find excellent, well-documented evidence of the full scope of fratricide

injuries. The three examples from this war are a byproduct of information collected for other reasons but in each case shed light on fratricide because the right questions were asked.

Like his World War I regimental surgeon counterpart, Dr. Besecker, Captain James Hopkins was a battalion surgeon with the 5307th Composite Unit (Provisional) often referred to as "Merrill's Marauders." He served in campaigns on New Georgia Island and in North Burma. During periods in both of these campaigns, as an individual effort because of his personal interest in the value of body armor, he meticulously recorded the mechanism and method of injuries of each individual soldier as they occurred. Lines of evacuation of wounded and killed always required that the wounded and dead pass through Hopkin's aid station, where he had personal contact with the patients. Therefore his records are unusually complete and, because of his interest and medical training, unusually accurate. He interviewed patients or other soldiers from the same unit about each casualty. He published both individual surveys in 1962. The New Georgia campaign surveyed 161 casualties and the Burma campaign 202. Hopkins identified friendly fire as causing between 13 and 14 percent casualties in both the Burma and New Georgia campaigns, when corrected for the TRADOC definition of fratricide.[19]

A third World War II example also comes out of the Pacific from a dedicated and resourced study of combat casualties. A team composed of physicians, ordnance staff, and technicians carefully studied every casualty as it occurred in what is referred to as the Bougainville Study in the Solomon Islands. Autopsies were performed on those killed. The 1,788 casualties incurred by the two divisions in this campaign were catalogued during the February-April 1944 period: 16 percent of the killed in action (KIA) and 12 percent of the wounded in action (WIA) were attributed to friendly fire.[20] Incredibly, the author used the Bougainville data to compare and contrast actual lethality of U.S. weapons on American casualties (219) versus Japanese weapons on American casualties (1,569).[21] No further comment appears about the high incidence of fratricide.

These three carefully collected World War II studies build on the anecdotal and very small data base of the earlier conflicts. Collectively they begin to paint a consistent picture that the issue of fratricide, when carefully monitored, is a much larger problem than previously appreciated. Before going on to the Korean conflict, there is one vivid example in World War II that makes the assertion of much higher fratricide rates more plausible. Although it involved inexperienced troops, the example speaks for itself.

In August, 1943, 35,000 U.S. and Canadian troops invaded Kiska, an Aleutian island, expecting tough Japanese resistance. The daylight assault was complicated by dense fog, and fighting continued through the night. By the end of the fight a day later, twenty-eight men were dead and fifty were wounded. There were no Japanese on the island.[22] This catastrophic "battle" continued for twenty-four hours-- against an enemy who wasn't there. Thus 100 percent of the casualties were fratricide. The miscalculation, misidentification, and error in this assault clearly exemplify what the conditions of combat, fear, and uncertainty can do to judgment. This example makes the acceptance of fratricide rates five or more times higher than the quoted two percent both understandable and reasonable in more difficult combat conditions.

The Korean War yields very little data on fratricide rates in spite of voluminous records and reports of casualties. Perhaps the main reason this was not pursued was the extensive use of U.S. weapons by the North Korean Army and Chinese Communist Forces (CCF). These came from U.S. forces, or forces armed by the United States, as well as copies made in Chinese arsenals. It was reported that whole units of the CCF were armed with the M1 carbine as well as the 1903 Springfield rifle.[23] In addition, they had large supplies of U.S. made machineguns and submachineguns. Type of ordnance therefore could not be used to indicate the origin of the person firing the wounding agent.

A dedicated Wound Ballistics Research Team was dispatched to Korea in late 1950 to do a careful survey, but they arrived just after the entry of the Chinese into the war. The team was denied country entrance and so set up a study of casualties in Japan.

After stabilization of the Korean front, several members of the team did manage to survey some casualties in Korea. The report of this Wound Ballistic Research Team is devoid of any comment on fratricide. Of interest, in a picture of small arms bullets removed from U.S. casualties in this report, of the twelve shown, six are U.S. weapon caliber. [24]

The Korean War was in the era of the first computers, and main frames were put to work. Most official studies were done after the war utilizing the 119,000 IBM punch cards where casualty data was recorded. Because of the limited abilities of computers, collection was confined to only fifty fields of data per casualty. Answers about causative agents were punched in as either small arms, fragments, or other general munitions categories.[25] Thus the introduction of computer-assisted documentation was not helpful in regard to fratricide determination. The right questions were never asked and therefore not recorded.

Where fratricide does surface in Korean War literature, the issue is not discussed. A limited study on the 25th Infantry Division during 26-31 July 1950, using casualty data computer cards, could only ascertain the weapon responsible for the injury in 47 percent of the cases. Within this study, the analysis of one regiment's casualties from bullets identified three of 44 casualties (6.8 percent) as from "friendly pistol, rifle." There is no subsequent discussion of this category anywhere in the report. As it represents only one type of fratricide, from bullets, and does not deal with the more common cause, artillery, the overall rate is undoubtedly higher.[26]

Casualty and wounding data is extensive from the Vietnam War thanks to a detailed survey between 1967-69 conducted *during* the war *in* Vietnam. Involving over 125 personnel and called Evaluation of Wounds Data and Munitions Effectiveness in Vietnam or WDMET Study, it was a dedicated and well-resourced effort that studied over 7,800 casualties during this two year period of time. It was a massive undertaking, collected case by case as they occurred, with thorough documentation including interviews when possible, extensive photographs, and meticulous searches for wounding agents and

their identification. Intended to study weapon lethality, body armor protection, and medical treatment requirements, the team was an integrated effort of many branches of the service: Ordnance, Artillery, Infantry, and Medical personnel all played major roles.[27]

In this extensive three volume report there are casualty data on 5,993 cases in one survey and a separate survey of 500 consecutive autopsy cases. Extensive information on the causative wounding agent was carefully collected in many cases. In the autopsy series, tables summarize this data by type of missile. Of the 161 fatalities due to identifiable bullets that were autopsied, 22 (13.7 percent) fatalities were from 5.56mm M193 (M16 rifle) bullets.[28] Analysis of the 186 fatalities caused by fragments in this autopsy series reveal a minimum of 20 (10.8 percent) of the deaths to have been caused by U.S. weapons-- assuming all mortar and grenade wounds were considered to be the result of enemy weapons (a doubtful premise). A tally of the weapons responsible for the 5,993 casualties show four U.S. weapon types (M-16 rifle, M-79 grenade launcher, Claymore Mine, and artillery) responsible for 11 percent of the all U.S. casualties.[29]

As straight forward as this data may seem, it is still open to challenge. The Viet Cong captured some American weapons and used them, including the M-16, therefore casting some doubt on who actually fired the M-16. A companion study in WDMET done by the Armed Forces Institute of Pathology carefully evaluated 56 KIAs by the specific bullet type to study lethality and ballistic characteristics. Included in this group were eleven killed by M-16 rounds. Four of these are recorded as having been killed by friendly fire, four more by "circumstances unknown", two simply as "KIA", and one by "enemy sniper." [30] Although small numbers, the acknowledgment of at least four fratricides in the group, and the ambiguity surrounding many of the rest, challenge the rebuttal that all these were caused by M-16s in enemy hands.

The last conflict to be reviewed is Operation Just Cause conducted in Panama late in December 1989. Lasting only a few days and characterized by night operations and small infantry tactics, it buttresses all the previous data and interpretation. Three of the 23

killed in action were due to fratricide. Of the 310 wounded, friendly fire wounded vary from a minimum of 16 to the more likely total of 31. The original 16 WIA friendly fire casualties were scattered about the country in several incidents. An additional 21 occurred in one incident where troops on the ground were misidentified by a AC-130 gunship. Therefore Operation Just Cause resulted in a fratricide rate of 13 percent among the KIAs, and between 5 and 12 percent of the WIAs.[31]

In every survey reviewed, the fratricide rate is many times higher than the two percent that appears in print as the nominal expected rate. Some surveys presented can be challenged in some respect. The World War II, Just Cause, and Persian Gulf War data are the most impeccable. As a whole, the surveys presented demonstrate a fratricide rate consistency from study to study that is much more convincing than the previous sources used to derive the earlier two percent estimate. As will be shown, wargaming confirms this impression.

TRAINING CENTER DATA

Before going on to fratricide data from the Persian Gulf War, combat training center experience with fratricide rates need to be reviewed. These centers include the National Training Center (NTC) at Fort Irwin, CA, the Joint Readiness Training Center (JRTC) now at Fort Polk, LA, and the Combat Maneuver Training Center (CMTC) at Hohenfels, Germany. Data on fratricide has been collected at some centers since 1985, and the last center, CMTC, since it was opened in 1989. The extensive use of controllers, computers, and technological innovations, including the use of MILES (Multiple Integrated Laser Engagement System) equipment, at these training centers allows for the careful collection and study of fratricide causes and rates.

The desert training area at NTC exercises armor and mechanized units over large, flat terrain where visual line of site is often good. Direct fire weapons (tanks, infantry fighting vehicles) that can visually identify their target are practiced extensively here. As

units oppose each other in mock battle, information is collected on shots fired: by whom and at whom. Special computerized equipment can track rounds fired from the identity of the firer to the identity of the target, creating what is called matched pairs (the firer paired with the target). It is unlikely we can get any better at tracking weapon fires and identifying casualties.

The Center for Army Lessons Learned (CALL) and the Army Research Institute (ARI) conducted detailed studies of direct fire records at NTC from 1986-1990.[32] NTC reports fratricide as a ratio of shots fired at friendly forces by friendly troops/ total shots fired. Fratricidal incidents there ranged from 5.6 percent of fires for defense in sector to 25.4 percent for deliberate attacks! To an offensively oriented Army, these are huge losses to fratricide. The average for all types of maneuvers was 11 percent fratricide.

This actual data can be easily converted to method two of fratricide calculation (the most meaningful method of fratricide calculation): the number of friendly troops a casualty by friendly fire / total enemy casualties inflicted. If 11 percent is the average accidental firing rate at friendly forces, then the other 89 percent are correctly aimed at the enemy. The ratio of fires at friendly forces to enemy forces is 11/89 or 12.4 percent. It must be remembered that although NTC simulates battlefield conditions in many realistic ways, it is not real battle with the additional anxiety of potential death. In addition, each unit only operates for several weeks. These battle figures are also with the additional advantage of knowing that fratricide is an issue studied there and vigorous attempts are taught to keep these losses at a minimum.

The Joint Readiness Training Center (JRTC) is composed of rolling, wooded terrain and involves infantry and combat support units. Distance visibility is not as good as at NTC and close combat and indirect fires (artillery, mortars,) more often employed. Data from this training center show a fratricide rate of slightly more than 7 percent over the last four years.[33] The first method of fratricide calculation is used: friendly casualties caused by friendly fire / total friendly casualties.

Fratricide at JRTC is frequent in spite of rigorous discipline to prevent its occurrence. This discipline includes heavy emphasis on rehearsals and "battle tracking," a system of frequently reporting unit positions between adjacent units. Indirect fires only account for 34 percent of the firing at JRTC but a stunning 75 percent of the casualties from fratricide. Like NTC, units are only tested for several weeks at a time.

The third Army combat training center, CMTC in Hohenfels, Germany has similar problems with fratricide. It reports out its fratricide experience using the third method discussed: as raw totals only, without the benefit of a denominator making comparison of fratricide rates with the other two centers impossible. With recent updates of equipment, CMTC will be able to present data comparable to either of the other two sites in the near future.

It should be pointed out that at all CTCs fratricide prevention is heavily emphasized. During periodic pauses in each training cycle, fratricide incidents are reviewed. They are examined in excruciating detail with the entire chain of command. It is hard to imagine the issue being more heavily emphasized.

It is at this point that the discussion of fratricide calculation is helpful. The fratricide calculations at JRTC use the older first method discussed (friendly casualties from friendly fire / total friendly casualties) and is consistent with the method used in all the historical evidence presented. The fratricide data from NTC uses a method easily converted to the second method of calculation, with the denominator enemy casualties. In the recently published Center for Army Lessons Learned newsletter on fratricide these two very different fratricide rates, derived by different methodology because of different logic, are in juxtaposition. In the same newsletter CMTC data is noted to have a "similar" experience although the data are not comparable.[34]

This combat training center data should have been an indicator of trouble ahead and was available before the Persian Gulf War. There is no reason that fratricide rates in war would be lower than in practice. Unlike prior conflicts, U.S. forces in South West

Asia had unique capabilities to identify losses due to fratricide. These included the use of weapon mounted video cameras to record hits and depleted uranium rounds that unequivocally marked their targets as United States hits. The short duration of the Persian Gulf War also allowed for immediate attention to be focused on battle damage evaluations. So it is against this background of significant training fratricide rates and more accurate determination of weapon results that the Persian Gulf War data should be viewed.

Many Americans, not familiar with the issue of fratricide, were appalled to learn of the high casualty rate in the Gulf War from our own weapons. Of the 613 U.S. military battle casualties in Operation Desert Storm, 146 were killed in action, including 35 (24 percent) killed by friendly fire. Of the 467 wounded, 72 (15 percent) were by fire from friendly weapons for an overall average of 17 percent.[35] A full 77 percent of all combat vehicles lost were destroyed by friendly fire![36] This is in spite of extensive training in the desert prior to the onset of the war, extensive and repeated rehearsals, use of Fire Support Coordination Lines (FSCL), combat identification markers on vehicles, the use of high technology navigational systems, and extensive liaison networks to integrate different ground elements and air elements.[37] How did levels of fratricide this high result from a war in which there was so much preparation to avoid it and a doctrine thought to be adequate to prevent it? The answer emerges from another area of research.

BEHAVIORAL RESEARCH

This paper has established from historical evidence during war and combat training center experience that fratricide (1) is a magnitude several times that previously acknowledged, (2) is arguably above that repeatedly demonstrated at our training centers, (3) approaches the estimates from the well-documented studies presented earlier from World War II and Vietnam, 10-15 percent, and (4) has been this high for the entire 20th century.

Support for these positions come from an important area of research: military and civilian studies on human behavior. There are factors operating at our combat training centers and during our wars that explain the existence of high fratricide rates in spite of our present preventative measures. These factors are (1) baseline performance ability and (2) degradation of skills by stressors, principally sleep deprivation.

As important as training, discipline, planning, and coordination are in the employment of weapons systems, the baseline results in many weapons systems are far from perfect. The limitations of the human operator in using these systems are well documented.[38] As an illustrative example, over the period 1985-89 at the NTC, Forward Observers could only reliably locate stationary targets with an error of 500 meters (five football fields), with only 1/3 of initial rounds either being effective or suppressive. [39] This data also does not include defective munitions that would induce additional errors. This was the state of the art at that time. Accuracy of Forward Observers in World War II with a target at 5000 yards was also off by as much as 500 yards, sometimes with the result that artillery shelled its own troops.[40] Reasoned thinking says both the Korean War and those conflicts prior to World War II had similar or worse experiences. There are numerous weapon systems that share the same problem as artillery with accuracy dependent on human judgment.

Add the effect of combat stressors and performance deteriorates quickly. The topic of stress was identified as a priority area of military research since as early as 1917. The reason is clear. Stress-induced decrements in performance are most likely to occur when they can be least tolerated-- during critical combat situations.[41] The degradation of combat skills associated with continuous operations are well-researched and published.[42] Sleep deprivation can begin to effect performance significantly 18 to 24 hours into continuous operations, declining 25 percent for every successive day that individuals are awake. But sleep deprivation effects are uneven. Skills requiring complex mental tasks are first affected, with purely manual tasks being least affected.[43] Such critical abilities as

command and control, fire control, orientation to friendly and enemy troops, and target designation and tracking are some of the first and most affected skills. In addition, planning activities, so important to success and fratricide prevention, deteriorate markedly.[44] In short, weapons can still be loaded and fired efficiently over time, but the abilities to exercise good judgment and employ the weapon correctly deteriorate much more rapidly. Abrupt and serious failures are prone to appear. In addition, vigilance is a big problem. Research recommendations include posting sentries in pairs during severe combat stress because of the propensity for visual illusions and failure to detect targets.[45]

> The tempo of warfare is increasing. It is becoming more and more evident that the human organism is one of the primary limiting factors in determining the success or failure of a military operation.[46]

It would appear that the pace of the modern battlefield is moving beyond the abilities of its human participants to react appropriately.

The consequences of degradation of ability quite logically spill over into fratricide. Combat identification failures and poor situational awareness are the two major reasons for fratricide and were the two main causes in the Persian Gulf War.[47] Situational awareness refers to land navigation errors (being in the wrong place) and insufficient coordination between units and individuals as they move about the battlefield with inaccurate or ill-defined target reference points. It is precisely these skills that are degraded early by continuous operations. A participant in the ground assault of the Persian Gulf War describes the situation:

> It was round the clock battle, a blow deep in the heart of enemy territory. It was fought at a furious pace, in rainstorms and sandstorms, with killing systems of ferocious ability. It left many soldiers...looking for help when picking out the good guys from the bad guys....[48]

The degrading of skills did not begin when contact with the enemy began. It began with the movement to contact and the sleep deprivation that started to accumulate as early as twenty-four hours previously.

Even rested, alert individuals are vulnerable to serious error under stress. Air Force research and work done by others demonstrates the effect of stress on error generation. Human attention capacity is thought to be limited in quantity and therefore allocated in proportion to the number of items needing attention and their importance. Threatening objects receive proportionally more attention than do non-threatening objects and information. This is referred to as attention gradient or divided attention. People placed in a life threatening environment allocate attention to the most threatening aspect, be it an aircraft, a tank, or a soldier. In a complex situation with many input variables impacting on the subject, contradictory evidence about what is assumed to be an enemy often gets very little or no attention when the expectation is that the target is the enemy. On the modern battlefield, this has serious implications. Situational awareness cues will decline so soldiers and equipment will be increasingly misidentified if the expectation is that the enemy is present.[49]

Researchers using early combat simulation models to assess the need for combat identification systems to prevent fratricide did not incorporate into their systems the large body of knowledge on the impact of the stressors on human performance and judgment.[50] This unintentional oversight resulted in an unrealistic expectation of consistency in human performance that lowered the projected fratricide rate.

In summary, a major reason the fratricide rate remains so high is that the imperfect human skill and judgment needed to employ weapons systems quickly degrades under multiple stressors, all made worse by the tempo of modern war-- continuous operations. "The stressors inherent in the combat environment ...impose severe debilitating effects on performance."[51] Our combat training centers reflect this fact and our experience in combat confirms it.

IMPLICATIONS

While the preventative measures employed to deal with fratricide are part of the

bedrock of its avoidance, the high rates of fratricide presented here and its explanation call for a reexamination of many issues:

Fratricide prevention must have the highest priority because our fratricide rates will become a serious political and ethical issue in future conflicts. This much higher fratricide rate of 10-15 percent has serious political implications. Public outrage over continued high fratricide rates could result in our inability to prosecute a war successfully. The country is now educated and understands the meaning of fratricide thanks to the extensive television coverage of the Persian Gulf War. Military briefers during that war educated the public using the first method of fratricide calculation. A repeat of the Gulf War fratricide rates in a future conflict will be unacceptable. The question will be harshly asked, why was this not fixed after Desert Storm? Discussions about using the wrong method of calculation or denominator will be drowned out by the call to fix the problem.

> Whether the loss, permanent or temporary, of 2 percent of the nation's military in a given conflict is significant and thus demands an extraordinary application of resources to avoid is a question that must be answered at the highest policy levels....[52]

With rates at least five times those cited above, the response should be immediate. Full attention and funding needs to be applied to this area.

Reducing fratricide rates in relation to the enemy's rates will be a significant battlefield advantage for the American military. "The impact of amicicide [fratricide] on combat power is geometric, not linear. Each fratricide incident represents one bomb, shell or bullet that should have fallen on the enemy to reduce his combat power rather than our own."[53] Our foes on the battlefield suffer from similar fratricide causes: baseline performance ability of weapon systems and declines in human abilities over time. Any significant improvement in fratricide rate for our forces will put our foes at an additional disadvantage. And the advantage is not only on the combat end of the equation. Every tank or vehicle spared is one less that has to be "force projected."

Current U.S. strategy is to harness technology to give us an edge on the battlefield. A reduction in fratricide rates by only half translates to a 5 to 8 percent increase in combat power. The opposite is true. Allowing the fratricide rate to rise because of emerging battlefield characteristics will significantly degrade our abilities to fight and win. This is another aspect of the technological edge we can leverage. Dare we allow this opportunity to pass us by? It is in fact a cost saving measure. It will spare equipment, lives, and wounded. A fratricide rate of 10-15 percent is a huge loss of combat power.

Our present preventive measures are not effective enough. Preventative measures including training, planning, and rehearsals were extensively employed before the ground campaign began in the Persian Gulf War. Although such actions have been effective to a degree, the residual rate of fratricide after their application is still too high. Our rates are high at our combat training centers. It is not for lack of attention to doctrine. Intensive efforts are used at all three combat training centers to teach methods of fratricide prevention and control. The Center for Army Lessons Learned (CALL) states in their 1992 newsletter *Fratricide: Reducing Self-Inflicted Losses*: "The key to solving fratricide problems is detailed planning and rehearsals to minimize predictable risks."[54] If this were really the case, incidents of fratricide would fluctuate by unit based on planning and rehearsal, not by type of engagement, as data from the NTC show. The range of fratricide fires extends from 5.6 percent for defense in sector, all the way to 25.4 per cent for the deliberate attack. The data argue for an inherent, intrinsic risk associated with each type of maneuver, rather than a planning or rehearsal issue. In addition, while planning is certainly critical to keeping fratricide incidents low, the evidence presented suggests it will only have a limited impact because of the pace of modern warfare and the degradation of this capability during continuous operations. We saw this in Desert Storm. In summary, it appears that we are already approaching the minimum levels of fratricide attainable using present preventative methods.

As an interim measure, a re-emphasis on the importance of sleep discipline will begin to address the steep decrements in performance and judgment associated with sleep deprivation. Initial emphasis must be on those personnel in command and control centers and key leaders from platoon level up. The heavy responsibilities of command and the continuous tempo of warfare will make this difficult to enforce to any degree.

The modern battlefield is predisposed to increased fratricide rates. Modern combat limits many of the fratricide prevention measures from being applied, such as planning and rehearsals.

> Continuous land operations is an advanced warfare concept. It is made possible by the almost complete mechanization of land combat forces and by the technology that permits effective movement at night, in poor weather, and in other low visibility conditions... The reasons that armies have traditionally paused in battle-- darkness, resupply, regrouping-- have been overcome largely by technological advances.[55]

One of the potentially weak links on the modern battlefield is the Army's most sophisticated weapon system, the soldier. Continuous operations require its human participants at times to exercise ability and judgment at a superhuman pace. This fact is repeatedly overlooked. Recent publications speak about fratricide as a result of direct human error, fire discipline, carelessness, and lack of coordination.[56] These statements are true but not enough. These errors are natural outcomes of human behavior in the environment into which we have placed the soldiers. While the AirLand Battle concept is terribly effective against the enemy, by its very nature, it is hazardous to friendly troops.

Technology will force the issue of an IFF-type of system for ground warfare. During the Gulf War, methods of acquiring targets in armored divisions were consistent at 3000 meters, with first round hits at 2500 meters, often beyond the ability to identify the target consistently. Given the age of these systems, present technologies in our laboratories allow acquisition of targets at 4000 meters, with the potential of 5000-7000 meters in several years.[57] This is well beyond visual identification abilities even with visual

aids. The air-to-ground Maverick missile shares this same technology/human mismatch. It must be fired as the aircraft approaches its ground target before visual identification of the target is possible. Its lock onto radar signatures does not discriminate between friend or foe.[58] The sophistication and range of modern weapons have outpaced the operators' ability to determine the friend or foe nature of the target. A positive identification capability out to the maximum range of weapon and target acquisition is necessary.[59] Technology will have to provide an answer to this problem.

Similar weapon systems between friend and foe will push us inexorably toward ground IFF technology. Many U.S. weapons are widely sold or reproduced throughout the world. It is very possible that future enemies will possess identical vehicles, tanks, and/or weapon systems. Sorting out friend or foe in night combat, combat with fluid lines, and in close air support missions will be impossible with present methods.

Even weapon systems on opposing sides that are developed independently are often distressingly similar in appearance. They look alike and have the same characteristics because of technical and engineering requirements used to push capabilities--a trend called convergent evolution. Military helicopters are a good example of this tendency to appear similar although developed independently.

Joint doctrine influence will require us to revisit the issue. The movement toward joint operations will require more complex coordination and command and control arrangements. Close air support has historically been plagued with difficulties in identifying friendly forces on the ground. The continued movement toward joint close air support under a single air manager will involve Navy, Air Force, and Army aircraft traveling hundreds of miles an hour with seconds over a target to decide friend or foe. This is fertile ground for fratricide. Weapon systems of different services will have to be integrated to an extent not yet attempted.

The "Force Projection" pillar of our National Military Strategy will increase factors favorable to fratricide. Cold War doctrine used the principle of Forward Defense,

initially utilizing troops already overseas, terrain oriented, time zone adjusted, and ready. The new strategy of Force Projection will insert large numbers of troops into a hostile, unfamiliar area after considerable travel time with its concomitant lack of sleep, time zone changes, and disruption of diurnal rhythms. All these are serious degraders of ability and judgment. The Persian Gulf War allowed weeks to train and acclimatize after the last combat units closed in theater. Fratricide can only get worse under more difficult circumstances.

The battlefield of the future, with a nuclear, biological, or chemical environment, will increase fratricide rates. Careful research on the effects of Mission Oriented Protective Posture (MOPP) equipment demonstrates up to a four-fold increase in fratricide rates over baseline when wearing this equipment for long periods of time. The MOPP equipment causes tremendous problems with vision and hearing. These sensing abilities are critical for command and control and coordinated physical performance.[60]

All this leads to the conclusion that an additional regimen needs to be added to our current plan for fratricide reduction. This has only recently become apparent. A 1982 TRADOC study concludes, "There is no significant evidence to indicate that existing operational command and control procedures are not sufficient to control fratricide to acceptable operational levels."[61] This is not true. Our high fratricide rates persist in spite of the preventive measures introduced. Our soldiers of today and tomorrow need a new approach to equip them to compensate for the effects of the battlefield. They need help in identifying friend and foe. The evidence is in our combat training centers and our recent wars.

A technological solution has generally been effective for the Air Force. Their identification friend or foe (IFF) system has successfully dealt with closing with targets before visual identification is possible. This system uses transmitters that permit pilots to query an IFF system on board an approaching aircraft. The appropriate return signal identifies a friendly aircraft: otherwise it is considered the enemy. The causes of the Air

Force fratricide against the Army helicopters in April 1994 are still to be determined. However, during the six week Persian Gulf War air campaign, there were no incidents of air-on-air fratricide. An integrated ground system has the same potential.

Such technological solutions to address the fratricide issue have met with some hostility.

> ...there appears to be an unwarranted faith in eliminating amicicide [fratricide] through the application of some technological remedy...the solutions to the problem of friendly fire, if any, are more likely to be human rather than mechanical. Increased emphasis on training, combat conditioning, fire discipline, planning and coordination of operations, and keeping the troops informed is likely to produce more joy than all the expensive technological toys combined. [62]

The causes of fratricide that the author of this statement lists include carelessness, stress of combat, lack of training, lack of discipline and fire control, and lack of coordination.[63] The studies of human behavior make clear that of these causes, all except lack of training have been demonstrated to degrade quickly during combat and are not amenable to compensation through training. Prevention of errors in these instances requires greater controls.[64]

The benefit to be gained from the use of technology is precisely because it can act as a safety check, or potentially as a control, depending on the system design. It adds another dimension of the known to all the unknowns of the battlefield. It is a backup for the anxiety, fear, uncertainty, and exhaustion that lay the seeds for fratricide. These factors have been with us since the beginning of modern armies, and successive strategies to deal with them have gotten us to where we are today. In spite of our efforts to prevent fratricide, the historical evidence indicates very little, if any, improvement.

We need to get our terms and methods of calculating fratricide to be consistent. The confusion on the matter of methodology has real implications. The two methods of fratricide calculation at present are somewhat similar in final result. This is just coincidence. The methods are fundamentally different equations. The fact the data from

both methods are used interchangeably is confusing and will give rise to wrong impressions unless carefully explained. Although all combat training centers emphasize fratricide prevention, they should use a common method of calculation to facilitate cross analysis and understanding. The combat training centers should have the capability to use the "gold standard" second method that reflects the efficiency of inflicting harm on the enemy (friendly casualties caused by friendly fire/ enemy casualties). Instrumentation at the CTCs could allow this kind of data to be captured and utilized. It may be that our high technology weaponry is very efficient in dispatching the enemy. If so, fratricide rates from this method will be low.

Unfortunately this denominator (enemy casualties) has not been available in combat operations, nor can anyone reasonably expect it to be available in future conflicts. We will have to settle for the historical method of presenting fratricide in war by using method one: percent of friendly casualties due to friendly fire / total friendly casualties. Therefore to compare fratricide data from war and training centers will require the use of both methods. Any mixing of methods needs to be carefully labeled and understood. There is one potential advantage to be gained from this recommendation. If fratricide rates are really lower by method two (not born out by NTC data), comparable results from our combat training centers calculated using both methods will allow us to explain our fratricide rates in war.

We must take the known limitations of human performance into account when running computer simulations and testing equipment for the battlefield. The body of knowledge addressing human abilities in continuous operations has been well articulated for the last twenty years. The steep decline in human abilities due to stressors like sleep deprivation have been plotted out over time. Incorporating this knowledge into simulations to project results and to evaluate weapons is a necessity to get accurate results of planned interventions. Few studies take this into account.

THE FUTURE

Fortunately, a reassessment of the priority given to fratricide prevention is beginning. After the Persian Gulf War, the House Armed Services Committee requested that the Office of Technology Assessment (OTA) review the technology and techniques available to reduce fratricide.[65] This excellent review concluded that the technology for avoiding fratricide of land surface targets lags behind the technology important to avoiding aircraft accidents.[66] It advocates priority funding to find better solutions. Our land systems are acquiring the same characteristics as those of aircraft-- rapid movement, short closing intervals to determine friend or foe, and usually lethal first shots. The OTA report, however, does not emphasize the tremendous effect of stressors on abilities and judgment.

Defense Department guidelines give the Army the lead agency status for ground-on-ground and air-on-ground combat identification systems. It appears the Army is moving along two fronts. The Army Materiel Command is pursuing two technologies to deal with combat identification and situational awareness. TRADOC is approaching the problem from the standpoint of leader development. These are mutually supporting strategies. "Technology is a great enhancer, and it supplements what is really the glue that holds the Army together-- training and discipline." [67]

In 1996 the 1st Cavalry Division will be the initial unit to be "digitized" under a long established effort to improve combat effectiveness. "Digitization" of the battlefield refers to the process in which voice, text and maps are converted into computer code. By linking forces on the battlefield into a single digital network, a commander can "see" the battlefield on a screen. This enables a commander to increase concentration and synchronization of fires, improve intelligence collection, and hopefully reduce fratricide by increasing situational awareness and combat identification.[68] This system was not conceived as an anti-fratricide system, although it could aid in that effort. However, it will be of no help to the individual who is not accompanied by vehicles, such as dismounted

infantry. A recently announced speed up of fielding calls for all of Force Package One, comprised of the XVIII Airborne Corps, to be digitized by the end of the century.[69] However, funding for the entire project is thought to be a serious problem.

A specific fratricide prevention measure under development is the millimeter-wave (MMW) device. This system sends out an interrogating signal that queries a target vehicle similar to the Air Force IFF system. If there is an appropriate coded response, the target is identified as friendly. This is also a vehicle mounted system that will not aid dismounted soldiers. A field test of the MMW device is expected in 1996. To provide each vehicle on the battlefield with such a device will be very expensive.

With regard to the fighting soldier, one point is certain. Soldiers who are casualties of friendly fire are no less brave or courageous. Many soldiers go into battle knowing the risks include fratricide, having met the issue at our combat training centers and observed its occurrence in training. A sort of gallows humor develops surrounding it. During World War II, the U.S. Ninth Air Force was so often off target and on friendly forces they were dubbed "The American Luftwaffe."[70] German troops in World War I resorted to calling their 49th Field Artillery Regiment the 48 1/2 because of the unit's propensity to fire short rounds on them.[71] The soldiers of the future will continue to have fratricide as their unwelcome companion on the battlefield. We must make the effort to avail ourselves of every possible means to reduce our high fratricide rates.

Finally, what should our attitude be toward those, who, under conditions of high stress and fatigue, are discovered to have inflicted friendly casualties while demonstrating no negligence? Even under the best of circumstances, if such a term can be used in war, fratricide will occur. The evidence presented here suggests its inevitability due to human factors and weapon/human mismatches in capabilities. With the failure of measures to prevent it, is it unfair to subject these individuals whom we have placed in a position of such certain errors, to the guilt of a mistake that is not theirs to carry? The modern

battlefield with vigorous, violent, continuous combat assures fratricide. Until an adequate combat identification system is in place, there will be many such individuals.

CONCLUSION

There is no blame placed here for what has happened in the past. We can not help that which was not evident before. Having pierced the fog of war over fratricide, the charge to our present and future leaders is clear. We must have a solution to this problem. Had such a system been possible during this century, the impact would have been tremendous. If a very conservative U.S. fratricide estimate of ten percent is used for the twentieth century conflicts, the following fratricide casualties result: 5000 killed and 23,000 wounded in World War I, 19,000 killed and 72,000 wounded in World War II, 5400 killed and 10,300 wounded in the Korean War, and 5,800 killed and 36,500 wounded in Vietnam. For later conflicts we have the actual counts presented earlier. The aggregate total is approximately 177,000 casualties. A 15 percent fratricide rate would mean a quarter of a million casualties as the consequence of fratricide in the 20th century. This is a tremendous loss of life and military manpower. In a human context it must not be allowed to continue. There will be more Koreas, Vietnams, and Persian Gulf Wars. We are approaching the potential to save thousands of lives and prevent thousands of wounded. Will the American public accept such losses in the future? As the lethality of war increases, we have the opportunity to improve the chances of survival of our troops in battle.

The halting revelations of history, validated by today's combat training center technology, and explained by soldier research on the battlefield and training areas, challenge us to act.

(1) We must acknowledge the magnitude of the problem. Fratricide rates have been and are conservatively 10-15 percent of our casualties, not two percent. This has existed for at

least the 20th century. The magnitude of this friction of war is a burden every soldier in the past had to carry. A careful education of the American people about the issue and our efforts to address it will help tremendously in the potentially difficult times ahead. It is a better strategy. The American people are very protective of their armed forces. They will support funding the effort for solutions. (2) The time for a technological initiative to decrease fratricide has come. The historical fratricide rate and combat training center data confirm the need. The battlefield trends of the future will require it. We must sustain the effort to find a solution. In the end, it will increase our combat power relative to our foe, conserve our resources, and save and protect human lives. (3) An armed forces-wide common strategy in fratricide calculation, presentation, and research needs to be developed. The present system is confusing to the military and to the public. (4) Research must reflect and emphasize the well-known effects of continuous operations on human ability and judgment.

This study relies to a great degree on data involving the Army, but the problems articulated here are joint ones. Airland Battle doctrine is a joint doctrine. There will be battlefields that all services will share. The Persian Gulf War was a paradigm of what is to come in the future. All services must solve this problem together. The clock has started. "It may well be that in the fog of war, friendly fire casualties are inevitable, but this solemn observation does not absolve the armed forces from doing everything in their power to eliminate the problem."[72] This is an investment of energy, time, and money we can afford to make.

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